5.0 TRANSPORTATION & PARKING

The Lowell community is well served by a clean, modern and efficient public transportation system. This system includes local and regional bus routes, passenger commuter trains, inter-city bus shuttles, airport limousine service and a modern multi modal transportation facility at the Gallagher Terminal.

Commuter trains provide convenient 40-minute travel service between Lowell and Boston's North Station with 21 trips per day. A 12-minute shuttle connects the Gallagher Transportation Terminal with the Lowell Business District. These trains also provide direct access to North Billerica, Wilmington, Woburn (and the Logan Airport Express Bus), Winchester, and Medford before arriving in Boston. In addition, 16 bus lines serve the city and the surrounding suburbs.

For those who do not have direct access to the Lowell Regional Transit Authority (LRTA) bus routes, the LRTA provides low cost parking at the Gallagher Terminal which connects via the 12 minute shuttle to the bus transportation center located downtown. Recently the LRTA began service to Burlington that will connect with the Massachusetts Bay Transportation Authority (MBTA) buses and is running service to the Pheasant Lane Mall in Nashua, NH. The LRTA also initiated bus service to Government Center and Haymarket Square in Boston through the MBTA.

The City of Lowell is fortunate to be served by an excellent regional highway system that provides direct access to the Boston metropolitan area as well as points to the west and north. Route 3, I-495 and I-93 are just minutes from downtown Lowell via the Lowell Connector. Boston is just 45 minutes by car; Route 128, 12 minutes. In addition, the coastal beaches of the north shore are less than 45 minutes away, and the prime New Hampshire skiing and hiking areas can be reached in 60 minutes.

This excellent transportation system translates into more jobs and services as companies' move into the region to take advantage of the transportation networks, available development parcels, and excellent labor force. While much of this development occurs in the surrounding suburbs, the City has still felt an impact through housing and commercial construction, and increased traffic. This increased population has resulted in growing pressures on existing services, as well as placing greater demands on the remaining open space.

5.1 CLASSIFICATION OF STREETS

The street classification in Lowell divides the City into five categories (see street classification map). The following is a brief explanation of each category.

- *State Highways*: carry major volumes of traffic and are often multilane divide roads with a few intersections at grade. They are part of or link directly to the Interstate Highway system. The traffic volume (ADT) is more than 30.000 at high speed, used for long trips for commercial vehicles. Cross sections may vary from 90 feet to 120 feet with a 60 to 84 foot pavement width.

- *Principal Arterials*: have the main function of carrying a huge traffic volume between one section of the city to another section. Land access is not their primary function. 2002 traffic volumes may be from 10,000 to 30,000 vehicles per day. Also in the peak hour principal arterial may have a lot of traffic that cross the city of Lowell on his way to surrounding towns or the state of New Hampshire. Cross sections of principal arterials

may vary from 60-80 foot rights-of-way with a 36-50 foot pavement width. Parking is not allowed in some sections of these arterials.

- *Minor Arterials*: carry most of the traffic form urban collectors and local streets to principal arterial. The land access is a tertiary use of these minor arterials. During peak hours, their level of service may be low due to increases in Lowell traffic. Cross section may vary from 45 to 50 foot right of way with a 32 to 36 foot pavement width. 2002 traffic volumes may be between 6,000 to 16,000 vehicles per day.

- *Urban Collectors*: serve the regular traffic movements between the city's districts and traffic from local streets to minor arterials. Cross sections may vary from 40 to 50 feet right-of-way with a 28-32 foot pavement width. Traffic volumes may vary from 2,000 to 10,000 vehicles per day. Any collector carrying more than 8000 vehicles per day is probably being used by through traffic (i.e., cut through traffic). Lowell appears to have many streets that are used as cut throughs. Additional capacity may need to be created on the more major roadways in the region to address the growing traffic generated by surrounding towns.

- *Local streets*: are moving traffic to access immediately adjacent land. Traffic volumes ideally are less than 2000 vehicles per day. However, in some areas there are local streets carrying heavier volumes. The traffic density in Lowell is medium to high and some local streets have reduced capacity due to cars parked in both sides.

5.2 Traffic Volume Study

Records of traffic counts in Lowell date back to 1990. Generally, annual traffic growth is around 2%, however some traffic corridors may have more than 2% of traffic growth. The traffic origin in Lowell varies. The average daily traffic volume ranges up to 2000 for local streets, from 2000 to 10,000 for collector streets, from 10,000 to 16,000 for minor arterials, and over 16,000 for expressways and principal arterials. Sources of traffic counts include the Northern Middlesex Council of Governments, Mass Highway, engineering consultants, and the City of Lowell.

Table 5-1
Traffic Volumes

Street	Traffic Count Location	2002 Volume
INTERSTATE 495	South of Route 38	133,818
INTERSTATE 495	west of Woburn St	110,702
INTERSTATE 495	North of Lowell Connector	104,741
Lowell Connector	over Industrial ave	59,687
Lowell Connector	south of Boston rd	48,800
Thorndike St	North of Lowell Connector	48,601
Thorndike St	between Gallagher and Highland	43,245
Route 113 / Pawtucket Blvd	West of Mamoth Rd.	40,008
Route 113 / Pawtucket Blvd	East of Varnum Ave.	37,980
Rte 38/Bridge St	North of Merrimack St	37,980
Lowell Connector	north of Boston rd	36,081
Wood St	before the bridge	35,609
Rte 38 / Nesmith St	at Hunts Fall Bridge	34,116
VFW Highway	between Mamoth Rd and Starbird St	32,806

Rte 38/Bridge St	North of VFW Hwy	29,810
School St	Over Merrimack river	29,500
Mamoth Rd	bridge at Pawtucket St	27,798
Rourke Bridge	at wood ext	27,492
Pawtucket Blvd	Front of Camelot apts.	26,548
VFW Highway	east of University Ave	26,411
Route 113 / Pawtucket Blvd	Near Camelot apts.	26,212
VFW Highway	west of rte 38	25,654
Rogers St	North of Bolyston St	25,257
Rte 38/Rogers St	North of Bolyston St	25,257
Church St	at Concord River bridge	24,888
Route 113 / Pawtucket Blvd	west of Varnum Ave.	24,136
Central St	South of Jackson St	23,257
Central St	North of Middlesex	22,917
VFW Highway	Eastbound, west of rte 38	21,825
Mamoth Rd	north of vfw hwy	20,166
Rte 38 / bridge St	at Dracut Line	19,121
Chelmsford St.	South of Stevens St	19,016
VFW Highway	between Aiken and Bridge st	18,747
VFW Highway	west of university ave	18,253
Route 113 / Pawtucket Blvd	west of rourke bridge	17,886
Andover St	At Tewsbury Line **	17,606
Chelmsford St.	west of Westford st	17,118
Mamoth Rd	west of meadow rd	16,892
Rte 38	South of South St	16,782
VFW Highway	westbound, west of rte 38	16,731
Appleton St	East of Lord Overpass	16,184
Industrial Ave	under Lowell connector	15,946
Merrimack St	East of John St	15,847
Fletcher St	south of Broadway	15,027
Route 110/vfw hway	at Dracut line	14,963
Industrial Ave	East of rte 110	14,795
Market St	west of Bridge st	14,721
Dutton St	East of Thorndike St	14,580
Woburn St	East of I 495	14,527
Merrimack St	east of bridge st	14,243
Appleton St	East of South St	14,220
Chelmsford St.	North of Lincoln St	14,018
Market St	west of Central st	13,633
Industrial Ave	South of Chelmsford St	13,213
Fletcher St	South of Pawtucket St	12,978
Moore st	east of Prince ave	12,587
Westford St	north of Chelmsford st	12,275
School St	South of Broadway	12,026
Stevens St	south of parker st	11,831
School St	South of Pevey st	11,741
Boylston St	North of Dayton st	11,702
Lawrence St	west of Billerica rd	11,491

Aiken St	South of Hall St	11,142
Westford St	east of cuples square	11,093
Route 113 / EB	East fo Mcom	11,037
Route 113 /EB	East of Old Ferry Rd.	11,037
Pawtucket St	West of Fletcher St	10,950
Green St	East of Central St	10,428
Branch St	East of Smith St	10,353
Varnum Ave	East of West Meadow st	10,020
Broadway St	West of Dutton St	10,016
Broadway St	East of Mt Vernon St	9,878
Gorham St	North of Central	9,850
Pawtucket St	West of Wilder St	9,725
Stevens St	North of Parker St	9,680
Branch St	East of Loring St	9,588
Lawrence St	east of Billerica rd	9,572
School St	North of Broadway St	9,403
Gorham St	North of Moore St.	9,393
Varnum Ave	west of VFW hwy	9,385
Gorham St	at Chelmsford TL	9,384
Lawrence St	at Concord river	9,384
Lakeview Ave	at Dracut Town Line	9,373
French St	at Magnum School	9,128
Wilder St	south of Middlesex st	9,122
Woburn St	west of I 495	8,947
Route 3A	Chelsmford town line	8,635
Middlesex St	east of Pawtucket st	8,576
Parker St	West of Stevens St	8,366
Lakeview Ave	west of rte 38	8,326
Stevens St	North of rte 3a Westford St)	8,281
Boylston St	South of I 495	8,219
Old Ferry Rd after lane rest	after lane restriction	8,115
Middlesex St	East of Saunders St	8,109
Middlesex St	east of South st	8,065
Broadway St	West of School St	7,904
Salem st	east of rte 38	7,397
Varnum Ave	South of Frenchette st	7,322
Clark Rd	At Tewsbury Line	7,066
High St	Between Andover and Merrimack Sts.	6,913
Steadman St	at Chelmsford Town Line	6,913
Wilder St (bridge const on school St.)	south of Pawtucket st	6,686
Central St	East of Gorham St	6,293
Middlesex St	West of Walker St	6,171
Princeton Blvd	at Chelmsford Town Line	6,093
Swan Rd		5,828
Dummer St	North of Broadway St	5,767
Sixth St.	East of rote 38	5,652
Rock St	East of Mt Vernon St	5,559
Old Ferry Rd	North of route 113	5,094

Lincoln St	West of Tanner	4,422
Clark Rd	South of Andover St	4,351
Parker St	East of Stevens St	4,183
Tanner St	south of Lincoln St	4,183
Walker St	North of Middlesex st	3,779
Hale St	West of Torndike St	3,537
Fourth Ave	NE of Mammoth rd	3,347
Lincoln St	East of Tanner	3,227
Walker St	at broadway St	3,146
Douglas St	North of route 38	3,015
Hildreth St	West of Bridge St	2,827
Tanner St	North of Lincoln St	2,510
Wentworth Ave.	South of Andover St	2,487
Meadowcroft St	south of Moore st	2,429
Totman rd	North of Varnium Ave	2,392
Third St	East of Bridge St	2,194
Adams Ter	North of Broadway St	2,054
Willie St	North of Broadway st	2,004
Mansur St	East of Nesmith St	1,865
Wentworth Ave.	North of Rogers st	1,741
Read St	2nd and 3rd Streets est of Bridge St	1,585
Lexington Ave	south of Varnum Ave	1,220
Sixth Ave	NE of Mammoth Rd	1,143
Dunbar Ave	South Varnum Ave	1,096
Billerica St	South of Lawrence St	1,072
Lincoln Ave	west of Gorham	1,040
Lexington Ave	south of Varnum ave	971
Fifth Ave	East of Mammoth rd	969
Lexington Ave	south of Varnum Ave	964
Fleming St	West of Stevens St	936
Barasford Ave		836
Entrance Gallagher terminal	off Thorndike St	786
Townsend Ave	between pawtucket blvd , Varnum ave	743
Townsend Ave	after restriction	648
Main St	South of Canada	598
Totman rd	at Photine	446
Olive St	off gorham st	332
Magnolia Avr	North of VFW	305
Stockbridge	North of VFW	304
Delaware Avenue	north of vfw	255
Bedford Ave	South of Varnum Ave	248
West London St	East of Tanner st	239
Jennifer Ave	South of Varnum	214
Melrose Ave	North of VFW	203
Shirley Ave	North of VFW	200
Totman rd	at Emprus st	163

*2% annual traffic growth rate assumed.

Source: Various, incl. DPD, NMCOG, VHB

5.3 Capacity of Streets

The capacity of a street is a measured by how many vehicles per hour can be accommodated in a segment without significant delays. Capacity is a function of the number and width of lanes, presence of proper breakdown lanes on highways, and a comfortable street width for safe travel on an urban arterial. Geometric characteristics of the streets help to decrease the level of service. In Lowell the majority of the major streets fall into the 40 to 50 foot right-of-way width category with parking on one or both sides of the streets.

Capacity of Lowell's major streets varies between 1300 and 8800 vehicles/hour. These figures assume an even traffic distribution for each direction of travel, level of service "E" or better for speeds less than 45 mph, a width factor between 0.90 to 1 due to narrow lanes, and a commercial vehicles factor of 0.95 which assumes a typical volume of commercial vehicles.

Level of service (LOS) is a rating of how comfortable and convenient it is to drive along a road or through an intersection. High quality of traffic service occurs when motorists are able to drive at their desired safe speed. For urban streets, a typical desired level of service is "C" which assumes a few traffic stoppages but no major delays.

The relation V/C gives an idea of traffic congestion, with being V the observed traffic volume and C the street capacity. An enclosed table indicates the V/C values for Lowell's major streets. The main traffic corridors have a relation V/C close to or greater than one (1). This relation indicates that existing traffic volumes approach or exceed the street capacity. Where peak hour counts are not available, the conservative assumption was made that the peak hour volume is equal to ten percent of the daily total volume.

Table 5-2
Traffic Volume/Capacity Analysis

Street	Segment Analyzed	Pavement width (ft)	Traffic Lanes Width (ft)	Shoulder (ft)	I. C. / hour	Fd	Fw	Fhv	R. C. / hour	ADT	V / hour	V/C
Wood st	Entrance to Rourke Bridge	26	26	0	3800	1.00	0.80	0.95	2888	35609	3561	1.23
School st	at O' Donnel Bridge	50	48	2	3800	1.00	0.93	0.95	3357	29500	2950	0.88
Bridge st	VFW hway/Sixth st	46	30	4	3800	1.00	1.00	0.90	3420	29810	2981	0.87
Gorham st	Moore st/Butler ave	32	30	2	3800	1.00	0.93	0.90	3181	27379	2738	0.86
Mamoth rd	VFW hway/Fourth st	36	34	2	3800	1.00	0.93	0.95	3357	27798	2780	0.83
Wood st	Princeton Blvd/Middlesex st	26	26	0	3800	1.00	0.88	0.95	3177	24762	2476	0.78
University ave	Pawtucket st/VFW Hway	38	36	2	3800	1.00	0.93	0.90	3181	23318	2332	0.73
Church st	Lawrence st/High st	36	30	6	3800	1.00	1.00	0.90	3420	24888	2489	0.73
Central st	Middlesex st/Jackson st	44	36	2	3800	1.00	0.93	0.90	3181	22917	2292	0.72
Stevens st	Parker st/Chelmsford st	29	28	1	2120	1.00	0.90	0.95	1813	11831	1183	0.65
Thorndike st	Gallager sq/Lord Overpass	70	64	6	3800	1.00	1.00	0.90	3420	21540	2154	0.63
Bridge st	Willard st/Dracut limit	44	38	6	3800	1.00	0.95	0.90	3249	19121	1912	0.59
Chelmsford st	Stevens st/Chelmsford border	45	33	6	3800	1.00	1.00	1.00	3800	21328	2133	0.56
Aiken st	Hall st/Perkins st	36	28	2	2120	1.00	1.00	0.95	2014	11142	1114	0.55
Andover st	Clark st/City limit	42	36	6	3800	1.00	1.00	0.90	3420	18462	1846	0.54
Stevens st	Westford st/Parker st	29	28	1	2120	1.00	0.90	0.95	1813	9680	968	0.53
Industrial ave	Lowell Connector/Composite way	40	36	4	3800	1.00	0.97	0.90	3317	15946	1595	0.48
Lakeview ave	South of Farmland	32	30	2	3800	1.00	0.93	0.95	3357	16120	1612	0.48
French st	Arcand Dr/John st	48	44	4	2120	1.00	1.00	0.90	1908	9128	913	0.48
Appleton st	Lor Overpass/South st	44	36	8	3800	1.00	1.00	0.90	3420	16184	1618	0.47
Merrimack st	John st/Central st	32	30	2	3800	1.00	0.93	0.95	3357	15847	1585	0.47
Chelmsford st	Stevens st/Plain st	36	32	4	3800	1.00	1.00	0.90	3420	15791	1579	0.46
Dutton st	Thorndike st/Broadway st	50	48	2	3800	1.00	0.93	0.90	3181	14580	1458	0.46
Fletcher st	Broadway st/Dutton st	36	33	3	3800	1.00	0.95	0.95	3430	15027	1503	0.44
Parker st	Stevens st/Wilder st	28	24	4	2120	1.00	0.97	0.97	1995	8366	837	0.42
Pawtucket st	Fletcher st/School st	46	34	2	3800	0.90	0.90	0.85	2616	10950	1095	0.42

Market	Palmer st/Central st	30	28	2	3800	1.00	0.93	0.95	3357	13633	1363	0.41
Middlesex st	School st/Saunders st	34	28	6	2120	1.00	1.00	0.95	2014	8109	811	0.40
VFW Highway	between Mamoth Rd and Starbird St	68	56	12	8800	1.00	1.00	1.00	8800	32806	3281	0.37
Pawtucket st	Wilder st/Broadway st	29	26	3	3800	0.90	0.90	0.85	2616	9725	973	0.37
Westford st	School st /Chelmsford st	36	30	6	3800	1.00	1.00	0.90	3420	12275	1228	0.36
School st	Broadway st/Middlesex st	36	28	8	3800	1.00	1.00	0.95	3610	12026	1203	0.33
VFW Highway	east of University Ave	32	26	6	8800	1.00	0.92	1.00	8096	26411	2641	0.33
Branch st	School st/Smith st	30	28	2	3800	1.00	0.93	0.90	3181	10353	1035	0.33
Middlesex st	West of Garent st	39	28	5	3800	1.00	1.00	0.90	3420	10779	1078	0.32
Broadway st	Fletcher st/Dutton st	30	28	2	3800	1.00	0.93	0.90	3181	10016	1002	0.31
VFW Highway	between Lakeview st and Bridge st	65	48	17	8800	1.00	1.00	1.00	8800	25654	2565	0.29
School st	Broadway st/Varney St	36	28	2	3800	1.00	0.93	0.95	3357	9403	940	0.28
Varnum ave	West Meadow st/VFW Hway	32	28	4	3800	1.00	1.00	0.95	3610	10020	1002	0.28
Stevens st	Westford st/Princeton Blvd	29	26	3	3800	1.00	0.95	0.95	3430	8281	828	0.24
Middlesex st	South st/Central st	39	30	3	3800	1.00	0.95	0.95	3430	8065	807	0.24
VFW Highway	west of university ave	30	26	6	8800	1.00	0.92	1.00	8096	18253	1825	0.23
Old Ferry rd	Rte 113 to Varnum ave	36	28	8	3800	1.00	1.00	1.00	3800	8115	812	0.21
Steadman st	at Chelmsford Town line	30	28	2	3800	1.00	0.93	0.95	3357	6913	691	0.21
Walker st	Middlesex st/Broadway st	30	26	4	2120	1.00	0.97	0.95	1954	3779	378	0.19
Wilder st	Pawtucket st/Broadway st	30	26	4	3800	1.00	0.97	0.95	3502	6686	669	0.19
West sixth st	Read st/Jewett st	28	26	2	3800	1.00	0.93	0.95	3357	5652	565	0.17
Adam st	Broadway st/Cross st	28	26	2	2120	1.00	0.93	0.95	1873	2054	205	0.11

I. D. / hour: Ideal capacity / hour
Fd: Distribution traffic factor.
Fw: Width lanes factor
Fhv: Comercial vehicles factor
R. C. / hour: Real capacity / hour
ADT: Average daily traffic
V / hour: Traffic volume assumed per hour
V/C: Relation Volume / Capacity

Source: City of Lowell Division of Planning and Development

5.4 Traffic Control Systems

The main streets in Lowell are controlled by 67 traffic lights, the majority of this equipment is outdated, and therefore the traffic must stop at almost all traffic lights. Lack of coordination between the lights along a traffic corridor, or traffic signal timing adjustments for peak hours inhibit smooth traffic flow. Vehicular detection systems are needed at most intersections.

Level of service of intersections is based on the average control delay per vehicle for various movements within the intersection. LOS is described as timing delay per vehicle crossing of the intersection. DPD evaluated the LOS for all the signalized intersection in Lowell. Also, Penonni Associates Inc., a consulting engineering company evaluated the LOS for downtown traffic signals.

As indicated on the maps, most of the traffic lights have a level of service "C" for am and pm peak hours. At mid day the average level of service is "B".

Critical signalized intersections in Lowell are located along Pawtucket Street near to the Merrimack River's crossings, Downtown area along Gorham-Central-Bridge Streets, Dutton Street and Nesmith Street. Lack of designated lanes for left turn movements increase the waiting time at many intersections and increases traffic congestion.

Based on the final downtown traffic study report made by Penonni Associates Inc. and review of some equipment at the traffic lights cabinets, DPD will begin improving the traffic flow in downtown through optimization of traffic signal timing, pausing, and coordination settings.

Pedestrian signals are located at most signalized intersections downtown. These signals should be updated with LED lights that save energy and last longer than incandescent lights.

The DPW Electric Department started converting all the red lights to LED four years ago. Currently, all the red traffic lights in Lowell are LED. However, the green and yellow lights still need to be updated.

5.5 Accidents and Safety

The number of accidents in Lowell has increased between 1998 and 2001 at a number of critical intersections around the city.

Accidents are caused by any combination of the following:

- traffic congestion
- high traffic volumes exceeding the capacity of the street system
- unsafe left turn movements
- unexpected pedestrian crossing streets in non designated area
- speeding
- uncertainty of the right-of-way in some intersections
- lack of driver education
- careless driving
- alcohol

Drivers making two lanes of cars where only one lane is designated to travel is a common cause of accidents in Lowell. Motorists making left turns never expect a car being squeezed along the curb line.

The speed limit for most streets in Lowell is 30 mph. According to speed studies made by the Lowell Police Department, 85% of the motorists travel at 30 mph or below; only a small percentage of the motorists travel over this speed.

DPD performed an accident study based on the Lowell Police Department data between 1998 and 2001. DPD plotted a graphic with the top 25 accident locations in Lowell. The top accident location is the intersection of Bridge Street and VFW highway with 140 accidents.

However, there are a number of critical congested intersections in Lowell. Delay time in peak hours in the afternoon is more than 90 seconds with level of service "D", "E", or "F" at the following locations. High congestion can be a contributing factor to the incidence of accidents.

1. Bridge Street-VFW Highway
2. School Street-Pawtucket Street
3. University Avenue-Pawtucket Street
4. Nesmith Street-Andover Street
5. Gorham Street-end of Lowell Connector
6. Lord Overpass
7. Central Street-Appleton Street
8. Central Street-Middlesex Street
9. Central Street-Middlesex Street
10. Merrimack Street-Dutton Street
11. Merrimack Street-Prescott Street
12. Dutton Street-Broadway Street

The highest rate of accidents occurred between 4:00 pm to 8:00 pm and during the Thursday-Saturday weekend period. Probable causes of these results include, afternoon traffic congestion, alcohol consumption on weekend nights, and speeding.

Fatality factor is a rating to qualify critical intersections involving injured persons, it is a result of dividing the number of persons injured by the total number of accidents.

5.6 Pavement & Sidewalk Condition

*This section is taken from a report prepared by VHB for the City of Lowell.

Lowell has 232.2 public road miles. The City accepted mileage is comprised of 225.7 miles of hot mix asphalt (bituminous concrete) surfaces, 3.0 miles of surface treated roadways, 1.6 miles of Portland concrete cement, 1.3 miles of cobblestone base and surfaced roadways, 0.4 miles of composite surfaces, and 0.2 miles of gravel roadways.

Within Lowell's public roadways VHB inventoried 232.5 sidewalk miles. The mileage is compromised of 174.0 miles of hot mix asphalt (bituminous concrete) sidewalks, 57.7 miles portland cement concrete sidewalks. VHB also inventoried and 2228 pedestrian ramps.

VHB determined that the City-accepted average road network PCI in the Winter of 1999 was 75, placing Lowell's typical road conditions in the middle of the Preventive Maintenance treatment band (PCI range from >73 to 85). This PCI average value generally represents a roadway in "good" condition.

An average road condition in the Preventive Maintenance repair band definition means that considerable resources will be needed to sustain network wide road conditions. It is likely that while any proposed pavement management spending plan will strive to maximize the benefit of each dollar spent, without a preemptive strike the system will undoubtedly continue to lose roads from the preventive maintenance category into the structural improvements and base rehabilitation bands. This very costly loss will present a challenge to Lowell officials if the City wants to retain its roads in good condition.

DISTRIBUTION OF ROAD CONDITIONS

A 1999 categorization of the surveyed roadway segments show that 9% (21.5 miles) of the roadway fall into the "Do Nothing" band; 15 % (33.7 miles) of the roads are in the "Routine Maintenance" band; 18% (41.4 miles) of the roads are in need of "Structural Improvement"; and 22% (52.2 miles) of the roadway segments are in need of "Base Rehabilitation". The highest mileage category for Lowell's roads is the "Preventive Maintenance" band. This indicates that these roadways are at a critical point in time where immediate attention is needed.

DISTRIBUTION OF SIDEWALK CONDITIONS

The 1999 categorization of the surveyed sidewalk segments show that 12% (27.5 miles) of the roadways fall in excellent condition; 43% (100.5 miles) of the sidewalks are in good condition; 36% (83.4 miles) of the sidewalks are in fair condition; and 9% (21.1 miles) of the sidewalks are in poor condition. (Figure 3)

CURRENT ROADWAY BACKLOG

Backlog is defined as the cost of bringing all roads up to near perfect condition within one year. The backlog not only represents how far behind the Lowell roadway network is in terms of its present physical condition, but it also measures the road repair costs to achieve varying PCI ranges. Current year backlog cost estimates offer a basis for comparison to future and/or past year's backlogs. Backlog is a relative measure of outstanding repair work and is not used as the basis for determining alternative scenario options. Rather, the City's goals for short and long term budgeting strategies.

As of winter 1999, Lowell's backlog of pavement surface repair work totaled approximately $43,000,000. This cost estimate consists of $31,000,000 in road reconstruction/base rehabilitation (72% of total backlog); $6,500,000 for structural improvement work (15% of total backlog); $5,300,000 in preventive maintenance (12% of the total backlog). Figure 4 summarizes Table 2 costs by treatment band. Note: that the five base rehabilitation categories add up to the most significant repair dollars even though they account for only 52 road miles.

5.7 Downtown Parking Analysis

There are currently ***4,818*** public off-street public parking spaces in the Downtown. These off-street spaces are distributed between four municipally owned and managed parking garages and one municipal public parking lot. As shown in the tables below, the biggest user of these public-parking facilities is Middlesex Community College, who uses over 1,350 public spaces on daily basis. Miscellaneous small businesses and residential properties, who use over 1,000 public spaces on a daily basis, are the second largest user of the parking garages.

In addition, there are approximately ***2,000*** off-street parking spaces that are privately owned, and ***418*** metered on-street spaces in the Downtown.

According to the analysis of the parking demand, there are ***867*** additional spaces in the Downtown. However, this surplus is not perceptible to our downtown employees, shopper, residents or visitors. In fact, there is a shortage of on-street parking (metered parking), specially on Market St, Middle St, and Merrimack Street. To add to this problem, the on-street parking spaces are being occupied all day by downtown business owners and employees. Overfeeding the meters ultimately leads many to underestimate the amount of available parking in the Downtown. An easy solution to this problem would be to fine people who overfeed downtown meters. If the parking laws were enforced in the Downtown area, a $15.00 dollar fine would correspond to 3 times more the daily parking rate in a public garage Metered parking spaces would be then available to shoppers and visitors.

The municipal parking garages are extremely affordable, compared with other cities of similar size:

Table 5-3
Parking Structure Pricing in New England Cities

City/ Town	Per hour	Per day	Monthly Pass
Lowell, MA	**$0.50**	**$5.00**	**$32.00**
Worcester, MA	$1.00	$5.00	$65.00
Providence, RI	$1.00	$8.75	$100.00
Malden, MA	$1.50	$5.00	$90.00

Data Source: DPD survey, 2001

Ultimately, the parking spaces surplus come from public and private off-street parking opportunities. The biggest complaint regarding Downtown parking is generally not the lack of parking. Instead, many businesses and residents have stated that those unfamiliar with the Downtown are not aware of parking opportunities or do not utilize these opportunities. The lack of signage to point out parking opportunities often leads to visitors to hunt for the limited amount of on street parking in the Downtown.

Future Development demands more parking availability. This study estimated an additional demand of ***1, 200*** spaces. The construction of a parking garage could be justified by the following projects: full redevelopment of Boott Mills, Massachusetts Mills, Canal Place III, and other smaller projects presented in this Plan.

5.7.1 DOWNTOWN ON-STREET AND OFF-STREET PARKING CAPACITY:

Over 400 metered spaces regulate short-term use (up to 2-hour parking limit), for customers, clients and visitors.

Table 5-4
Downtown On-Street Parking Capacity

Street	On-Street Parking Spaces
Merrimack St.	112
Market St	41
Middle Street	43
Palmer	11
Paige St	12
Central St.	29
Kirk St.	9

John St.	11
French St.	0
Arcand Drive	25
Worthen St.	3
Shattuck Street	10
Church St	6
Hurd St	22
East Merrimack	39
Warren St	19
Lee St	15
Cardinal O'Connor	11
Total On-Street Parking	**418**

Source: DPD Survey (2001)

Table 5-5
Downtown Public Off-Street Parking Capacity

Ayotte Garage (2000)			
Total Spaces	**1,250**		
Passcard Holders	1,057		
		Lowell High - Teachers	*346*
		Lowell High - Students	*333*
		City of Lowell	*299*
		Whittier Partners	*71*
		Individual	*8*
John Street Garage (2000)			
Total Spaces	**1,141**		
Passcard Holders	901		
		Boott Mills	*211*
		Lowell High - Teachers	*128*
		Lowell Sun	*34*
		Marcotte Law Firm	*20*
		OET	*41*
		Health Department	*35*
		Leahey Eye	*15*
		Lowell Five Bank	*20*
		National Park Service	*41*
		Misc.	*356*
Lower Locks Garage (1997)			
Total Spaces	**1,200**		
Passcard Holders	1,052		
		Commitment to Doubletree	352
		Commitment to MCC	700
Leo Roy Garage (1997)			
Total Spaces	**1,012**		
Passcard Holders	967		
Davidson Street Parking Lot			
Total Spaces	**215**		

TOTAL PUBLIC OFF-STREET PARKING CAPACITY: 4,818

Source: DPD Survey (2001)

Table 5-6
Downtown Private Off-Street Parking Capacity

Location	Spaces Provided
Canal Place Parking (Market Place)	58
Mass Mills Parking Lot (Bridge St)	360
Boott Mills Parking Lot (French St.)	120
Wannalancit Mills Parking Lot (Suffolk St)	296
Lowell Five Parking Lot (Paige St)	25
Fred C. Church Parking Lot (French St)	96
Post office Parking Lot (Arcand Drive)	98
River Place Towers Parking Lot (French St.)	320
Enterprise Bank Parking Lot (Merrimack/ Middle St.)	112
Arcand Drive Professional Bld. Parking Lot (Arcand Drive)	62
Appleton Bank (Central St.)	35
Lowell Co-Operative Bank Parking Lot (Hurd St.)	12
Gateway Center Parking (I & II)	98
Baghaw Mills Parking (Warren St)	16
NPS Visitor Center Parking Lot (Dutton St.)	135
Bridge St (Lenzi's Catering)	50
Athenian Corner (Market St.)	11
Worthen House	40
Masonic Center (Arcand Drive)	38
Union Bank	12
Middlesex Community College	38
Total Off- Street Privately Owned Parking Spaces	**2,032**

Source: DPD Survey (2001)

Table 5-7
Downtown Total Off-Street Parking Capacity

Location	Spaces Provided
Off- Street Parking - Public	4,818
Off-Street Parking - Private	2,032
On-Street Parking	418
Total Parking Spaces Available:	**7,268**

Source: DPD Survey (2001)

5.7.2 DOWNTOWN LOWELL PARKING DEMAND:

According to the City's zoning ordinance, a retail establishment, a restaurant, or office in Downtown Lowell does not need to provide parking. The two tables bellow compare the City's parking standards with the most common standards used for parking provision:

Table 5-8
Parking Demand Standards

Land Use	Standard	Required Parking Spaces (B3 Zoning)	ITE Recommended Parking Spaces
Residential	Dwelling Unit	1	1.11
Retail or Office	1,000 S.F.	---	3.23
Restaurant	1,000 S.F.	---	2.79
College, University or School	Seat	---	0.3
Church	Student	---	0.5
Other Public Use	Seat	---	0.3
			1

Source: City of Lowell Zoning Code & Parking Generation, August 1987/ Institute of Transportation Engineers

If we follow the most common standards for parking provision, the following parking spaces would be necessary:

Table 5-9
Downtown Core Retail Parking Demand by NAICS Code

	Number of Businesses	Total Square Footage	Parking Spaces
4422 – Home Furnishing Stores	2	5,174	16.7
4431 – Electronic and Appliance Stores	1	858	2.7
4442 – Lawn and Garden Equipment Stores	1	4,200	13.5
4452 – Specialty Food Stores	2	2,930	9.46
4453 – Beer, Wine and Liquor Stores	2	3,327	10.7
4461 – Health and Personal Care Stores	3	10,662	34.4
4481 – Clothing Stores	6	27,158	87.7
4482 – Shoe Stores	1	5,326	17.2
4483 – Jewelry, Luggage and Leather Stores	5	7,890	25.4
4511 – Sporting Goods, Hobby and Instruments Stores	2	7,103	23.0
4512 – Book, Periodical and Music Stores	4	12,645	40.8
4529 – Other General Merchandise Stores	2	7,074	22.80
4531 – Florists	2	4,110	13.2
4533 – Used Merchandise Stores	3	8,455	27.3
4539 – Other Misc. Merchandise Stores	1	2,810	9.0
Total Retail Businesses / Parking Spaces Required	**37**	**109,722**	**337.16**

Source: DPD Survey (2000)

Table 5-10
Downtown Core Restaurant Parking Demand

	Number of Businesses	Seating Capacity (approx.)	Parking Spaces Required
7221 – Full Service Restaurants	26	1,071	**321**

Source: DPD Survey (2000)

Table 5-11
Downtown Core Office Parking Demand

	Number of Businesses	Total Square Footage	Parking Spaces Required
4214 – Professional and Commercial Equipment Supplies and Wholesalers	2	20,294	56.62
4431 – Electronics and Appliance Stores	1	1,408	3.90
4441 - Building Materials and Supply Dealers	1	8,400	23.4
4481 - Clothing Stores	1	16,203	45.20
4511 - Sporting Goods, Hobby and Musical Instrument Stores	1	14,553	40.6
4543 - Direct Selling Establishments	2	5,530	15.4
5111 – Newspaper, Periodical, Book and Database Publishers	1	46,964	131.0
5121 - Motion Picture and Video Industries	1	994	2.77
5211 - Monetary Authorities - Central Bank	5	53,883	150.3
5222 – Non-Depository Credit Intermediation	3	5,953	16.60
5311 - Lessors of Real Estate	4	8,445	23.5
5313 - Activities Related to Real Estate	2	1,887	5.26
5411 - Legal Services	35	97,129	270.98
5412 – Accounting, Tax Preparation, Bookkeeping and Payroll Services	1	1,500	4.10
5414 – Specialized Design Services	2	4,532	12.64
5415 – Computer Systems Design and Related Services	4	15,401	49.96
5417 - Scientific Research and Development Services	2	30,494	85.0
5418 – Advertising and Related Services	2	5,794	16.1
5616 – Investigation and Security Services	1	867	2.41
5619 - Other Support Services	1	8600	23.99
6116 - Other Schools of Instruction	1	4783	13.3
6211 - Offices of Physicians	4	19093	53.26
6212 - Offices of Dentists	3	3806	10.60
6213 - Offices of Other Health Practitioners	6	22129	61.7
6214 – Outpatient Care Centers	2	12514	34.90
6241 – Individual and Family Services	10	42527	118.65
7115 – Independent Artists, Writers and Performers	1	1470	4.1
7224 - Drinking Places	2	9494	26.48
8132 - Grant-Making and Giving Services	2	6485	18.0
8133 - Social Advocacy Organizations	1	1500	4.18
8139 - Business, Professional, Labor, Political and Similar Organizations	4	36764	102.57
9211 – Executive, Legislative and Other General Government Support	7	67929	189.5
9221 - Justice, Public Order and Safety Activities	1	2360	6.58
Total upper story businesses / Square feet occupied/ Parking Spaces required	**120**	**617,660**	**1,623.55**

Source: DPD Survey (2000)

Table 5-12
Downtown Core Educational/institutional Parking Demand

Name	# of Students	Spaces required
Middlesex Community College	3,393	1,696.5
High- School Students	3,000	1,500.0
Total Students/ Parking spaces required	**6,393**	**3,196.5**

Source: DPD Survey (2000)

Table 5-13
Downtown Core Residential Parking Demand

# of Dwelling Units in Downtown	Spaces required	*Spaces required adjusted to real demand
1,511	1,677.21	**921.94**

*The adjusted value was based on the Residential Survey done by DPD in 2000-2001. According to the survey, 45% of the residents never use the car as a mode of transportation. It can be assumed that 45% of the population does not own a vehicle, and do not need a parking space. The total spaces were adjusted to 55% of the total required.

Parking Capacity versus Parking Demand for existing Land Use:

Total Spaces Available- Demand = 7,268– 6,400.15 = +867.85

5.7.3 PARKING DEMAND FOR POTENTIAL DEVELOPMENT

Additional Parking spaces to be created considering a 0% vacancy rate of Retail and Office Space and considering potential Development opportunities in the Downtown:

Table 5-14
Potential Downtown Core Development Parking Impact Analysis

Type of Space	Existing vacant space (S.F.)	Size of the Potential Development (S.F.)/ units (approx.)	Number of Parking Spaces Required	Number of Parking Spaces Added
Retail space				
Downtown existent vacant space	38,728		125	---
Arcand Drive Lot	---	30,000	96.9	**150**
Fred C. Church Lot	---	30,000	96.9	**600**
Market Place Center	---	50,000	162	**450***
Merrimack St Infill (Enterprise Bank Parking Lot)	---	6,000	19.38	---

Office Space				
Downtown existent Vacant Space	196,273	----	547.6	---
Boott Mills Phase III	----	440,000	1,228	
Fred C. Church Lot		60,000	177.4	
Merrimack St Infill (Enterprise Bank Parking Lot)	---	12,000	33.44	
Residential				
Surf Building	----	63 units	69.3	
Canal Place III	----	80 units	96.8	*
Massachusetts Mills III	----	218 units	239.8	
D.L Page Building	----	10 units	12.1	
Richardson Block	----	6 units	6.6	
Other Types of Use				
Arena- Post office Lot- Future Sports Complex	**---**	200,000	300	---

Total Spaces required for Future Development: **3,214**

* The parking garage will be shared by Canal Place III, retail and the NPS Visitor Center.

A	Total Parking Spaces removed due to the Future Development of the above parcels	**643**
B	Total Parking Demand from Future Development of the above Parcels	**3,214**
C	Total Parking Spaces added in future development of the above parcels	**1,100**
D	Future Parking Demand versus parking spaces added (B-C)	**-2,114**
E	**Surplus from present parking capacity:**	**+867**
F	**D-E**	**-1,247**
G	Existent Parking Capacity (On-Street + Off-Street)	**7,263**
H	Future estimated Parking Capacity (On-Street + Off-Street)- **(G - A) + 1,100**	**7,720**

Source: City of Lowell DPD Downtown Plan (2001)

5.8 Traffic Patterns

Travel patterns for the City of Lowell vary depending on the time of day and types of vehicles involved. Resident traffic, commuting traffic, deliveries, local business traffic, and services and utilities traffic present distinct travel patterns.

During AM and PM peak hours, the traffic congestion from resident and non-resident commuters significantly delays the travel time between districts in the city. Cut-through traffic on side streets is becoming common in Lowell, leading to an increasing number of accidents, further delays, and reduced visibility on sharp corners.

FUNCTIONAL CLASS

- State Highway
- Principal Arterial
- Minor Arterial
- Urban Collector
- Local Street

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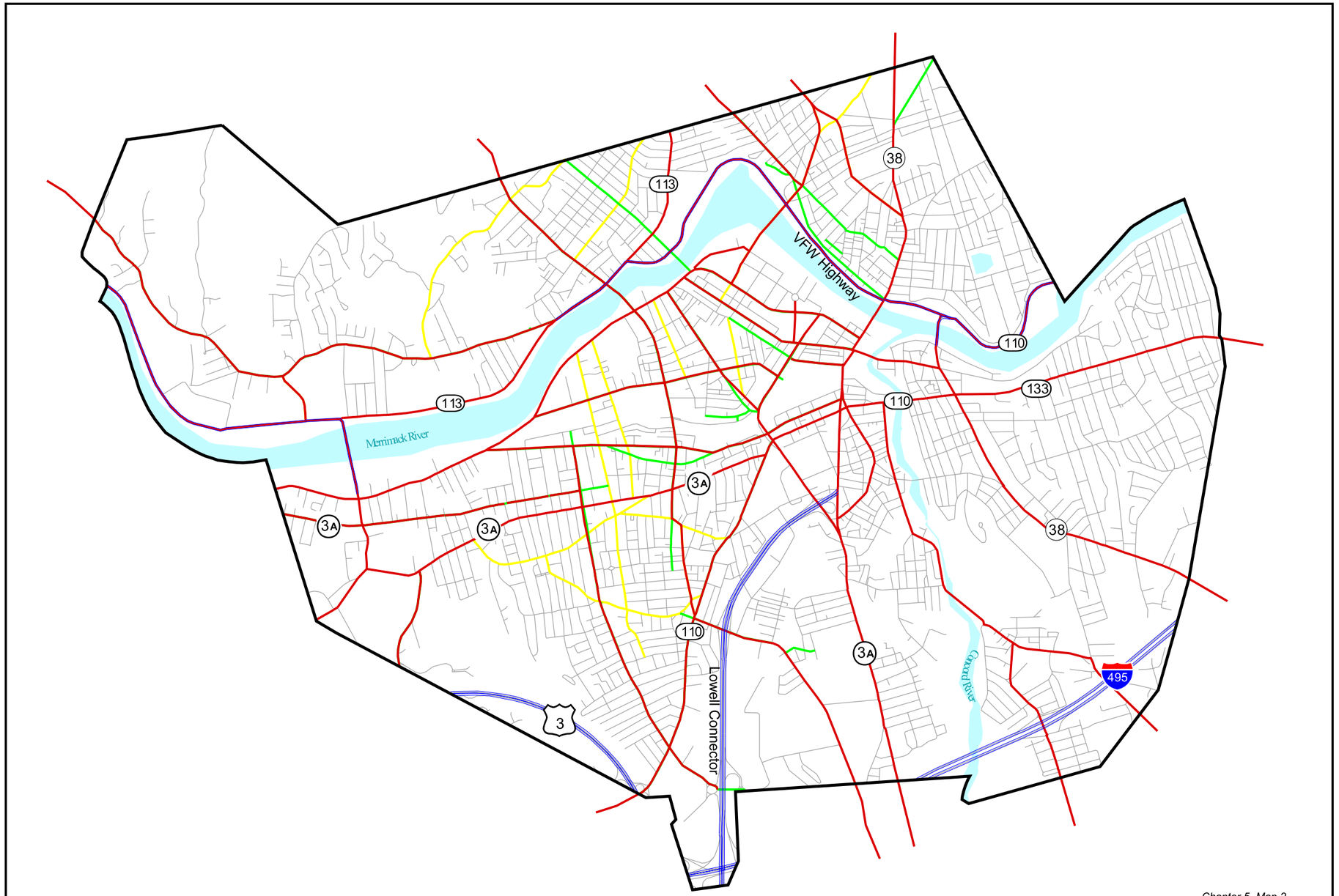

Chapter 5, Map 2

Street Classification

LOWELL COMPREHENSIVE PLAN
January 2002 Existing Conditions

N

0.8 0 0.8 1.6 Miles

Division of Planning and Development

STREET STATUS

Accepted

Not Accepted

State

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Chapter 5, Map 5

Street Status

LOWELL COMPREHENSIVE PLAN
January 2002 Existing Conditions

N

0.8 0 0.8 1.6 Miles

DPD

Division of Planning
and Development

Gallagher Intermodal Station

Downtown Shuttle Route

LRTA Bus Routes

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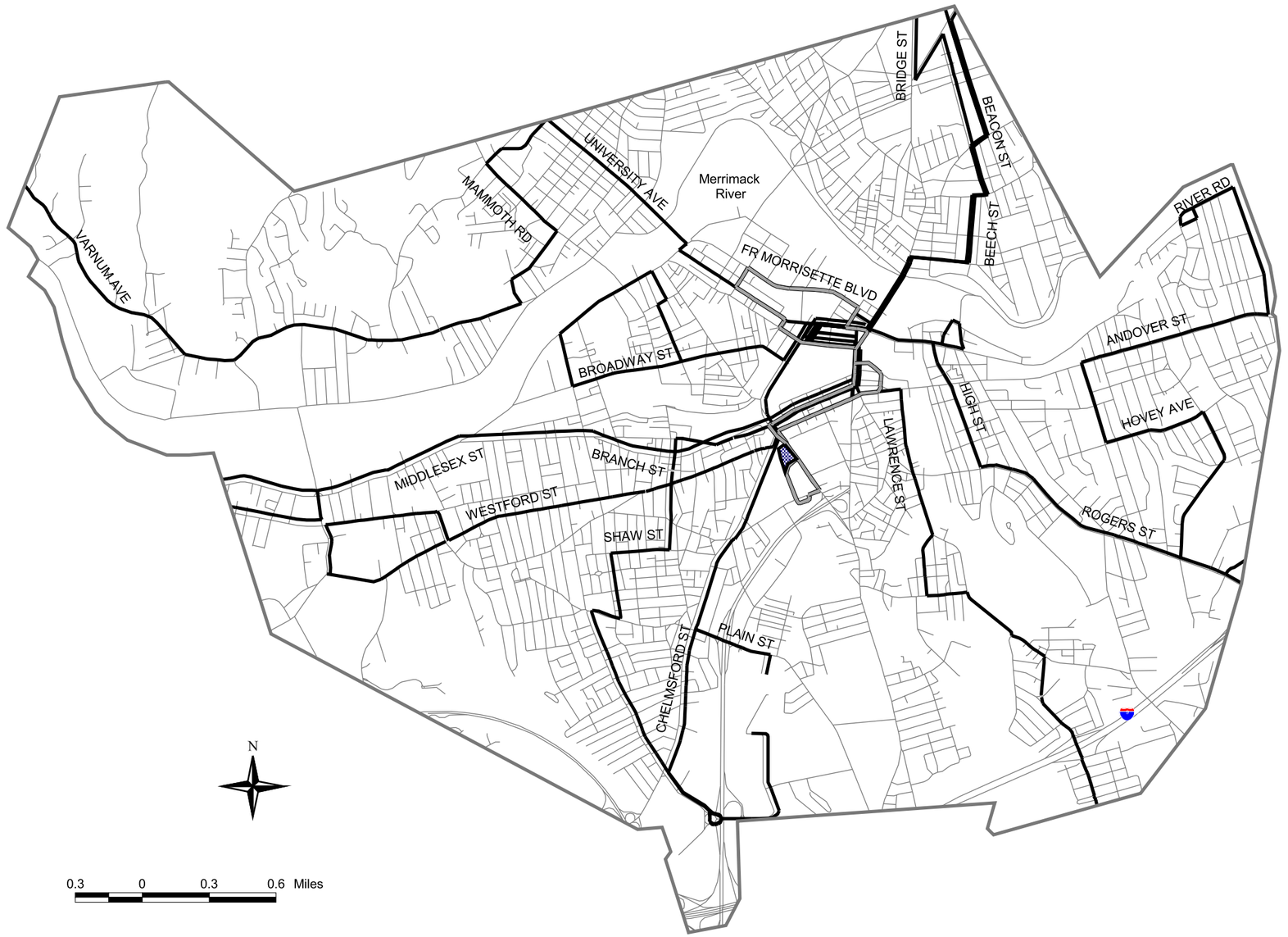

Chapter 5, Map 10

Public Transportation

LOWELL COMPREHENSIVE PLAN
January 2002 Existing Conditions

Division of Planning and Development

AM Peak
Level of Service

★	A
⊙	B
▲	C
✚	D
□	E
◑	F

Level of Service Criteria for Signalized Intersections

Level of Service	Control Delay Per Vehicle (Sec)
A	<= 10
B	>10 and <= 20
C	>20 and <= 35
D	>35 and <= 55
E	>55 and <= 80
F	>80

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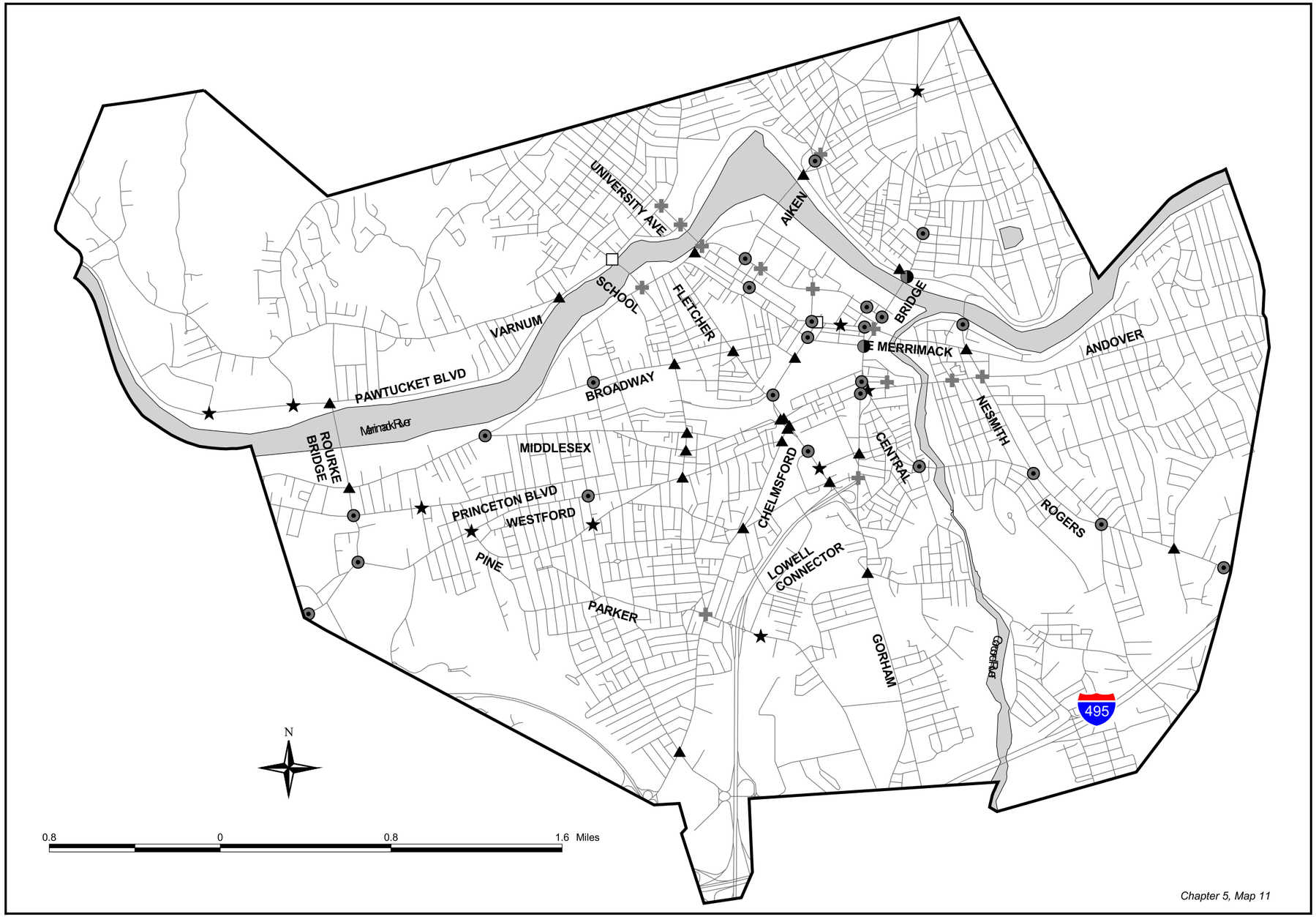

Chapter 5, Map 11

AM Peak Level of Service for Signalized Intersections

LOWELL COMPREHENSIVE PLAN
January 2002 Existing Conditions

DPD
Division of Planning and Development

MID DAY PEAK

Level of Service

★	A
⊙	B
▲	C
✚	D
□	E
◑	F

Level of Service Criteria for Signalized Intersections

Level of Service	Control Delay Per Vehicle (Sec)
A	<= 10
B	>10 and <= 20
C	>20 and <= 35
D	>35 and <= 55
E	>55 and <= 80
F	>80

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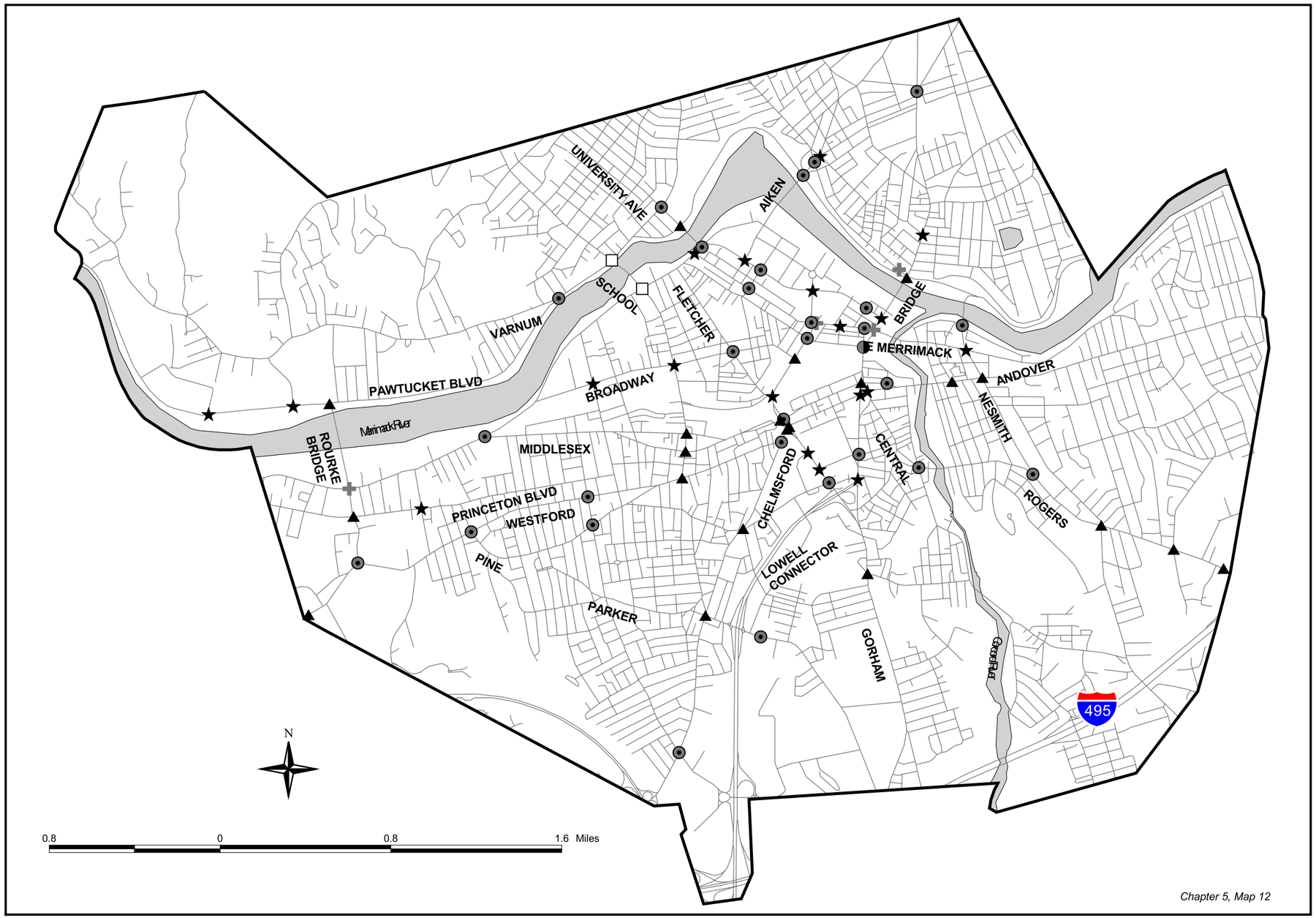

Chapter 5, Map 12

Mid Day Peak Level of Service for Signalized Intersections

LOWELL COMPREHENSIVE PLAN
January 2002 Existing Conditions

Division of Planning and Development

PM PEAK
Level of Service

★	A
⊙	B
▲	C
✚	D
□	E
◑	F

Level of Service Criteria for Signalized Intersections

Level of Service	Control Delay Per Vehicle (Sec)
A	<= 10
B	>10 and <= 20
C	>20 and <= 35
D	>35 and <= 55
E	>55 and <= 80
F	>80

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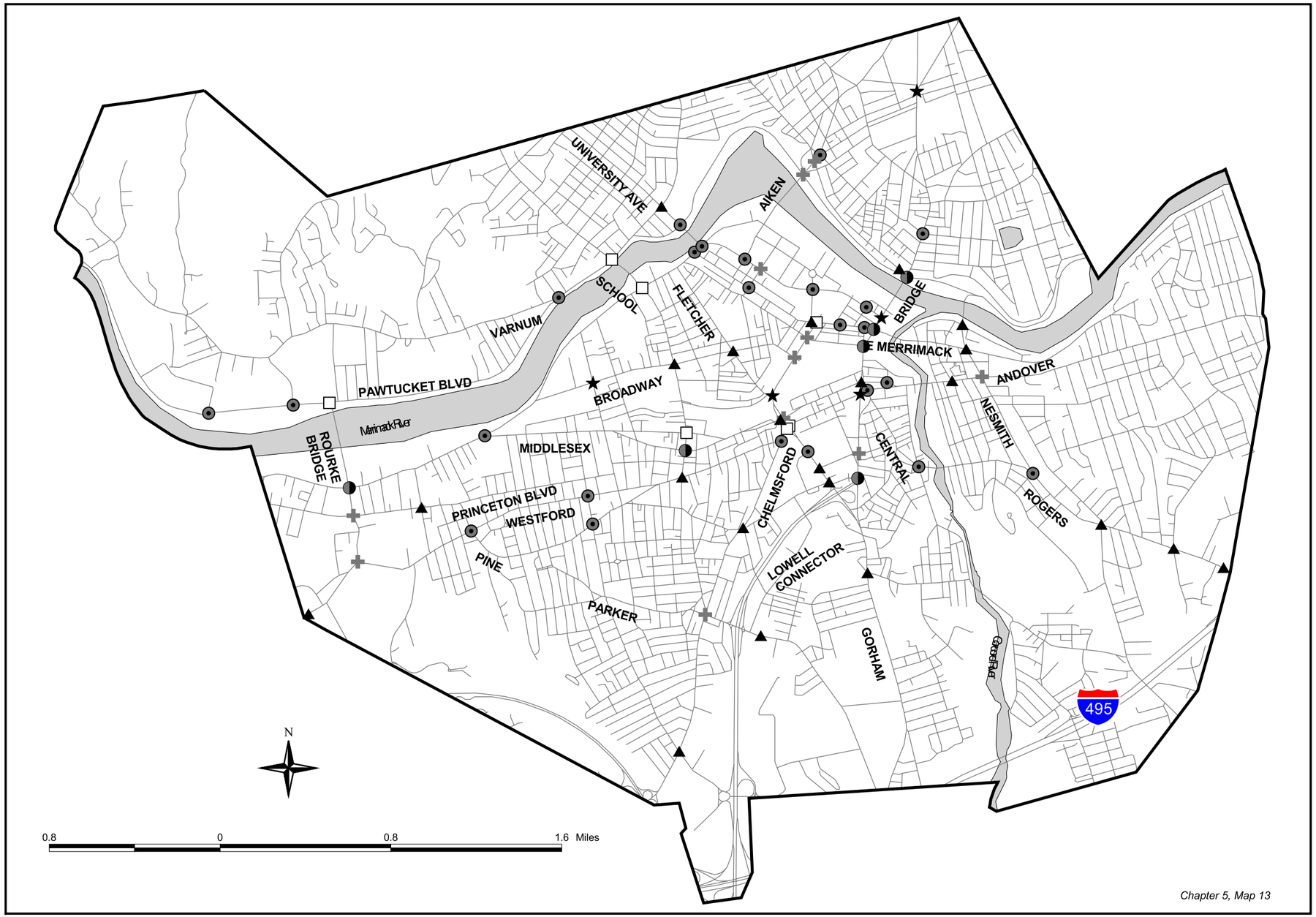

Chapter 5, Map 13

PM Peak Level of Service for Signalized Intersections

LOWELL COMPREHENSIVE PLAN
January 2002 Existing Conditions

DPD
Division of Planning and Development

AVERAGE DAILY TRAFFIC VOLUMES

- 0 - 2,000
- 2,000 - 6,000
- 6,000 - 10,000
- 10,000 - 16,000
- 16,000 - 30,000
- 30,000 - 50,000
- > 50,000

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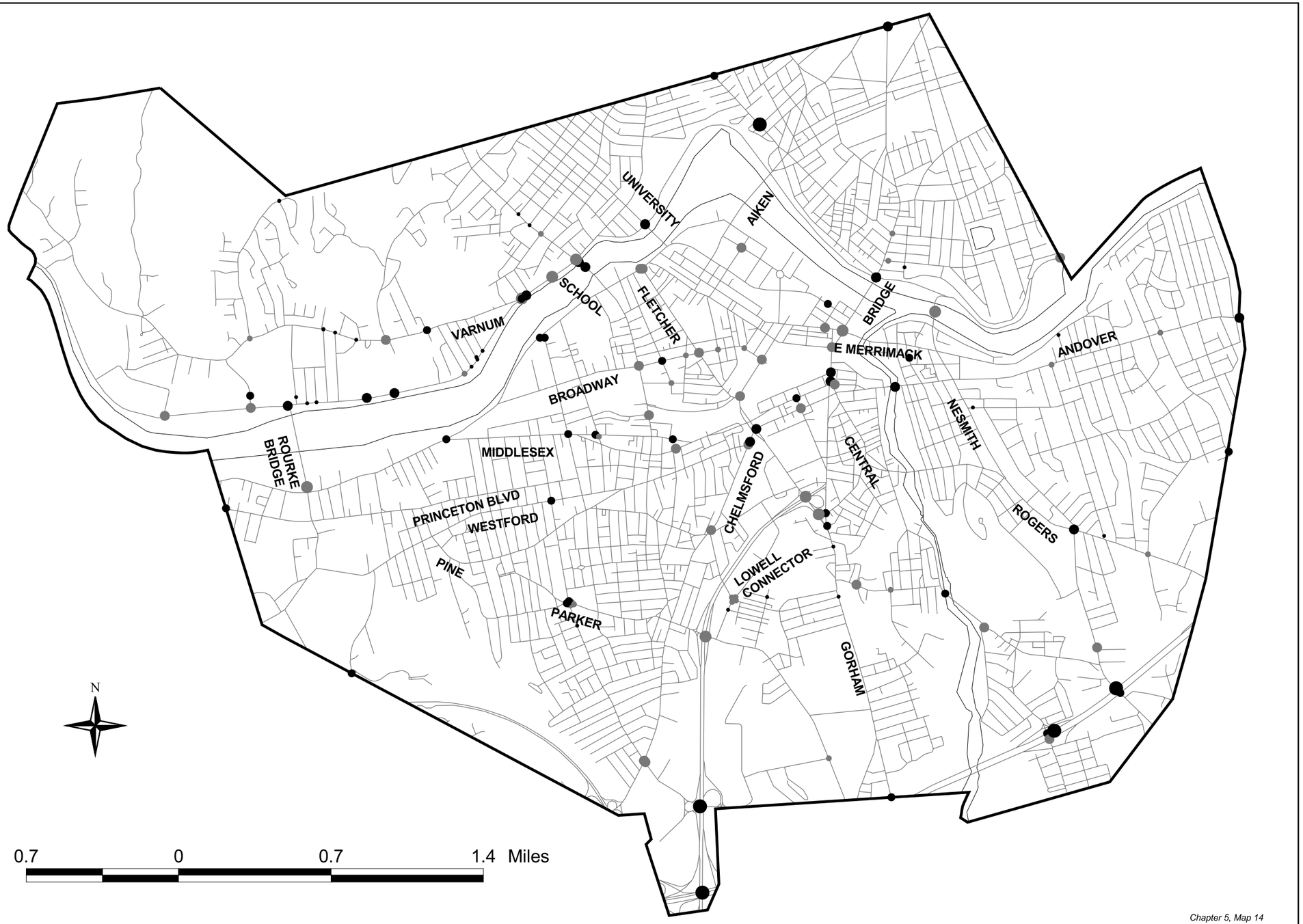


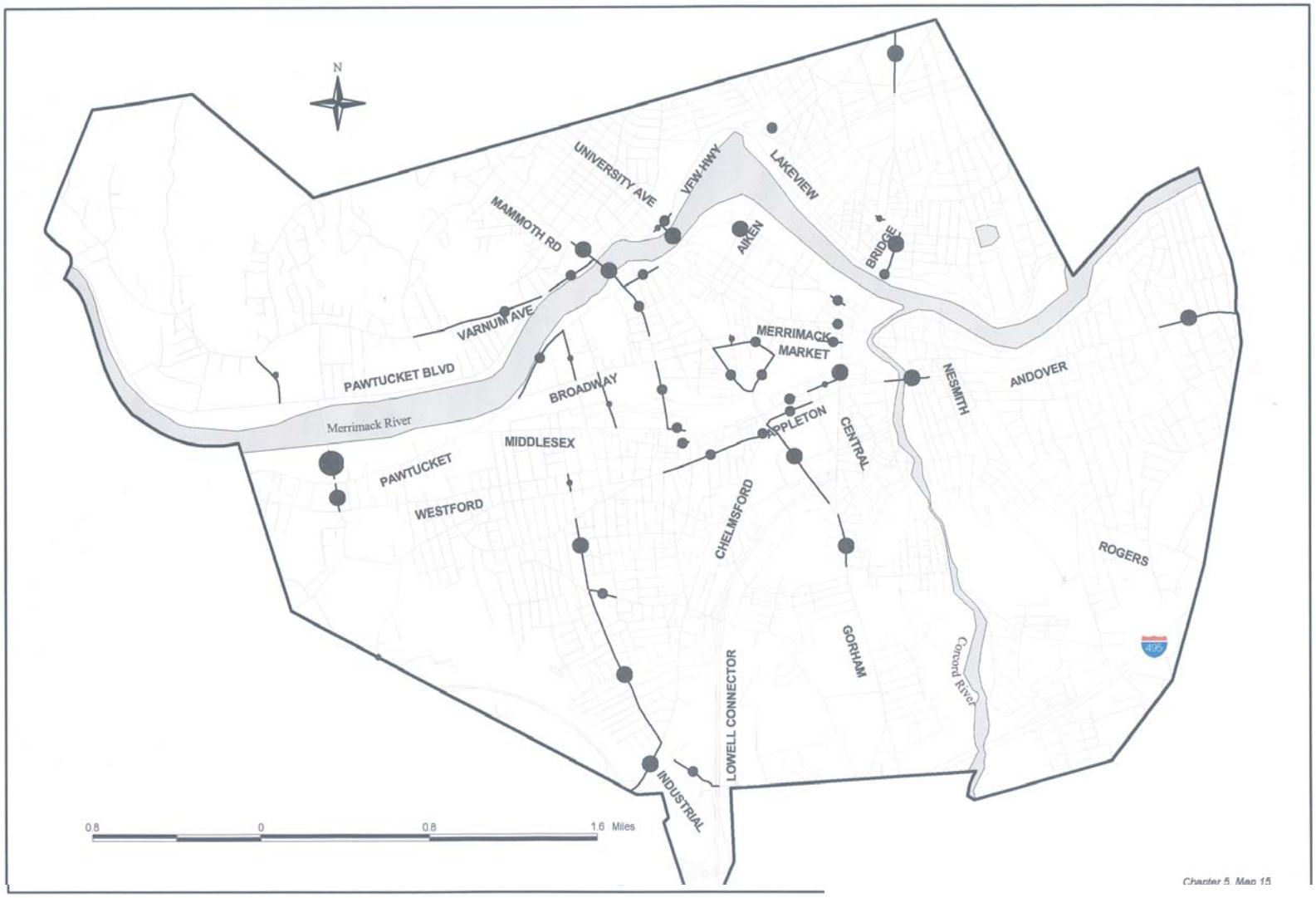
Chapter 5, Map 14

Traffic Volumes

LOWELL COMPREHENSIVE PLAN

January 2002 Existing Conditions

DPD
Division of Planning and Development



Relation Between Traffic Volumes & Capacity

LOWELL COMPREHENSIVE PLAN
January 2002 Existing Conditions

DPD Division of Planning and Development

• Stop Sign Location

** Per City Ordinance Only*

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N

0.8 0 0.8 1.6 Miles

Chapter 5, Map 8

Stop Signs

LOWELL COMPREHENSIVE PLAN
January 2002 Existing Conditions

DPD
Division of Planning and Development

- Accident Location

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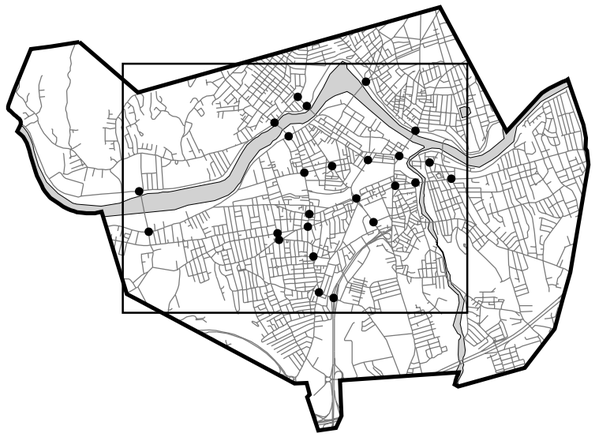
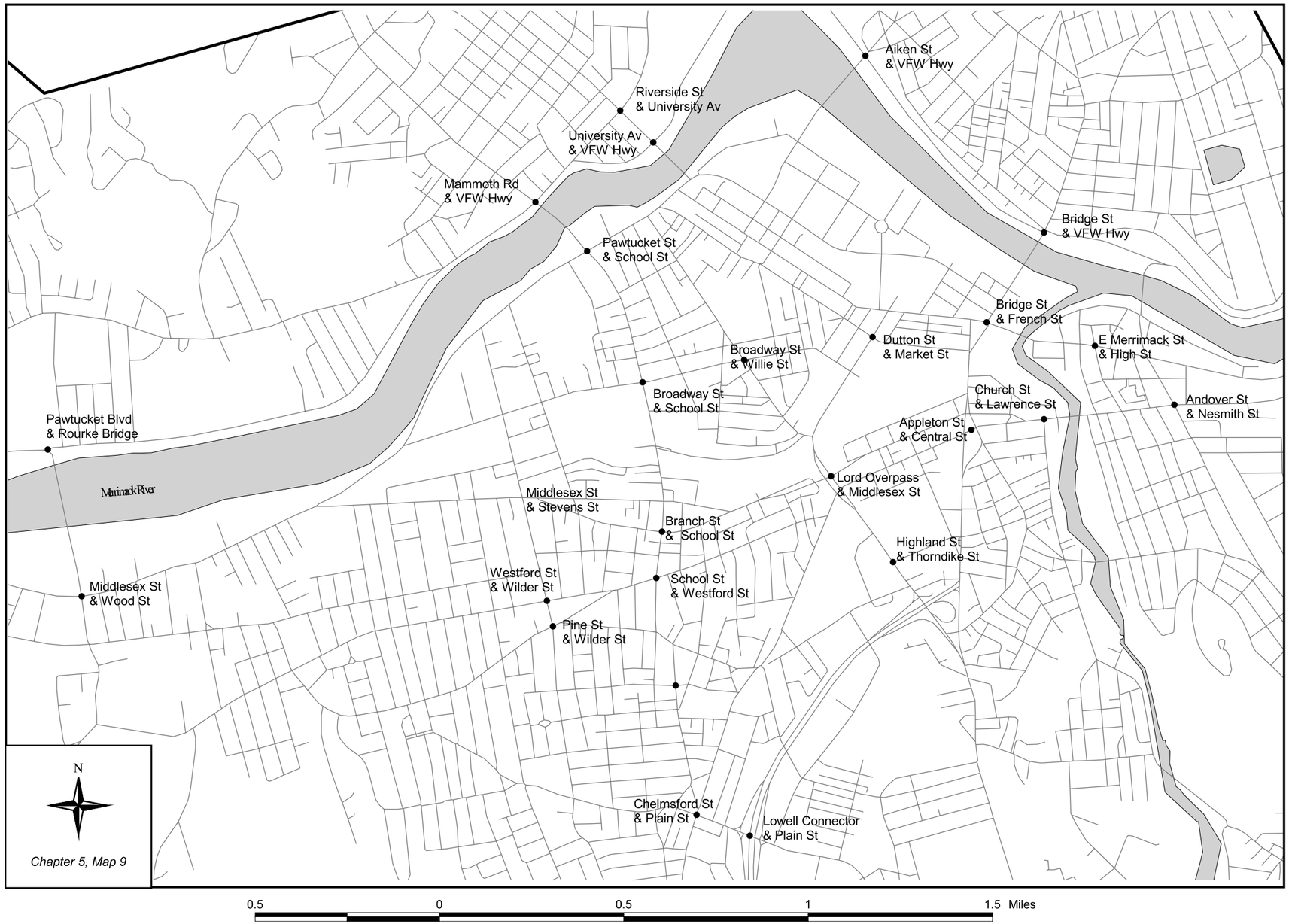
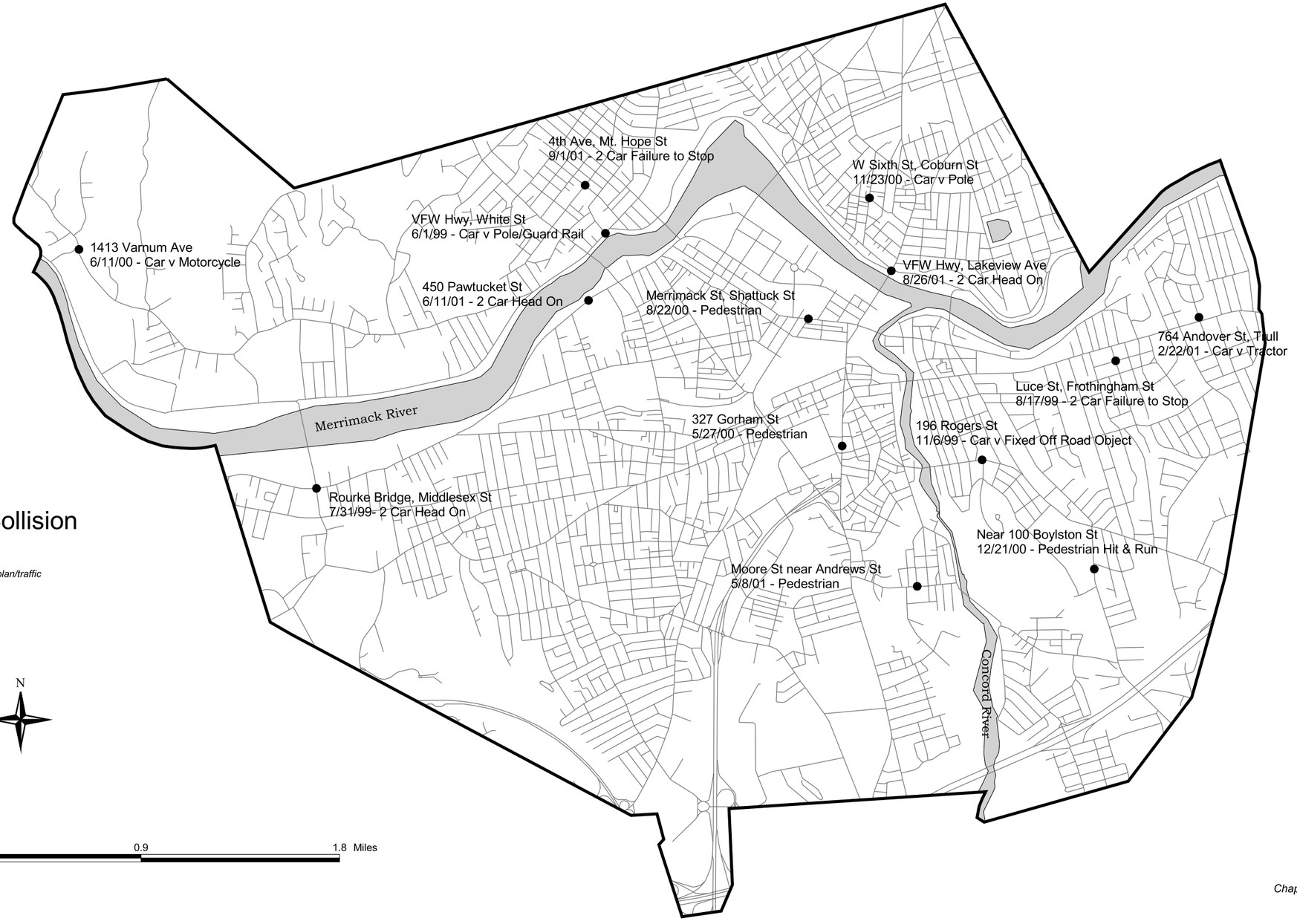




Top 25 Accident Locations

LOWELL COMPREHENSIVE PLAN
January 2002 Existing Conditions

Division of Planning
and Development



- Location, Date &Type of Collision

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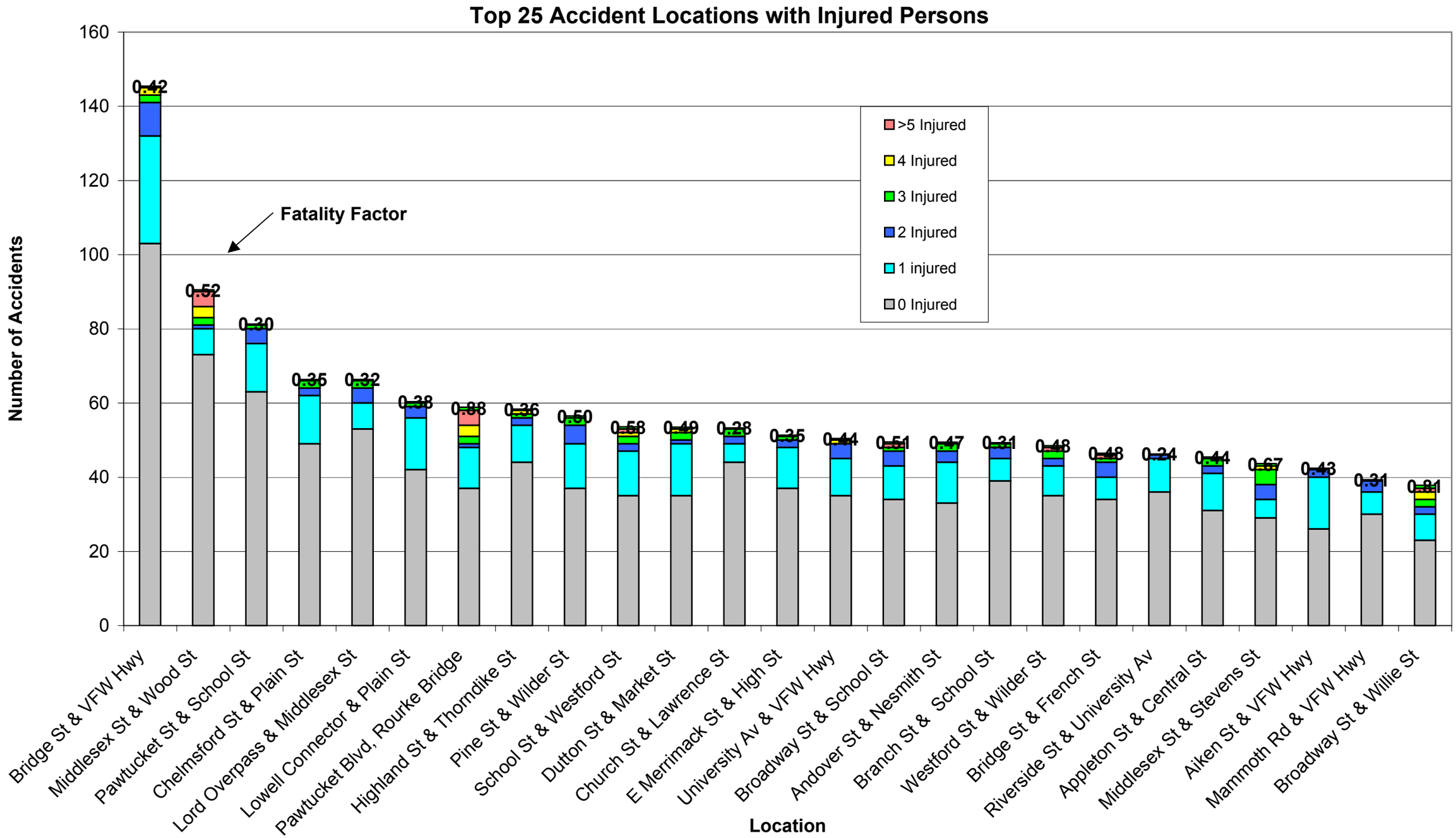
Chapter 5, Map 7

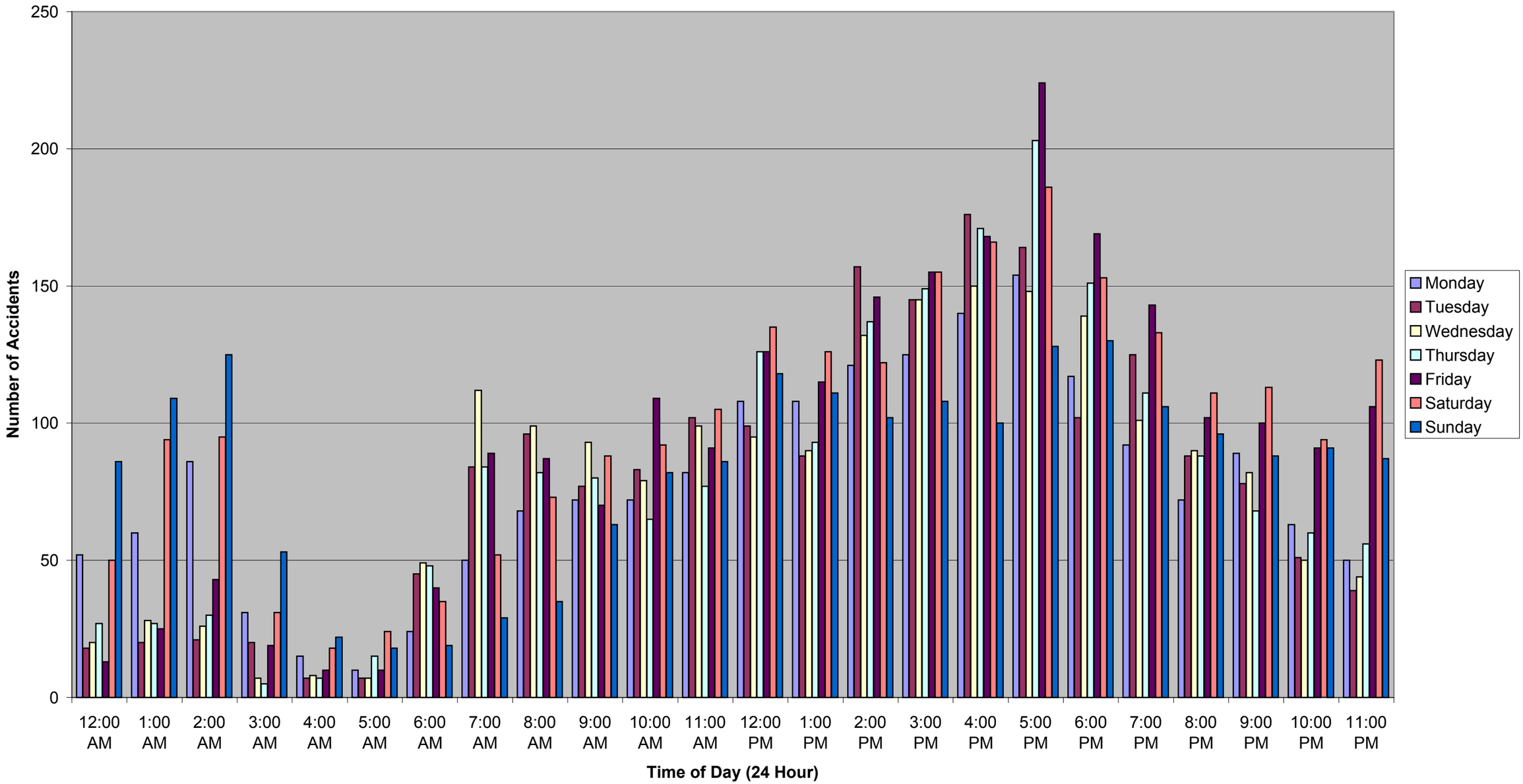
Fatal Accident Locations

LOWELL COMPREHENSIVE PLAN
January 2002 Existing Conditions

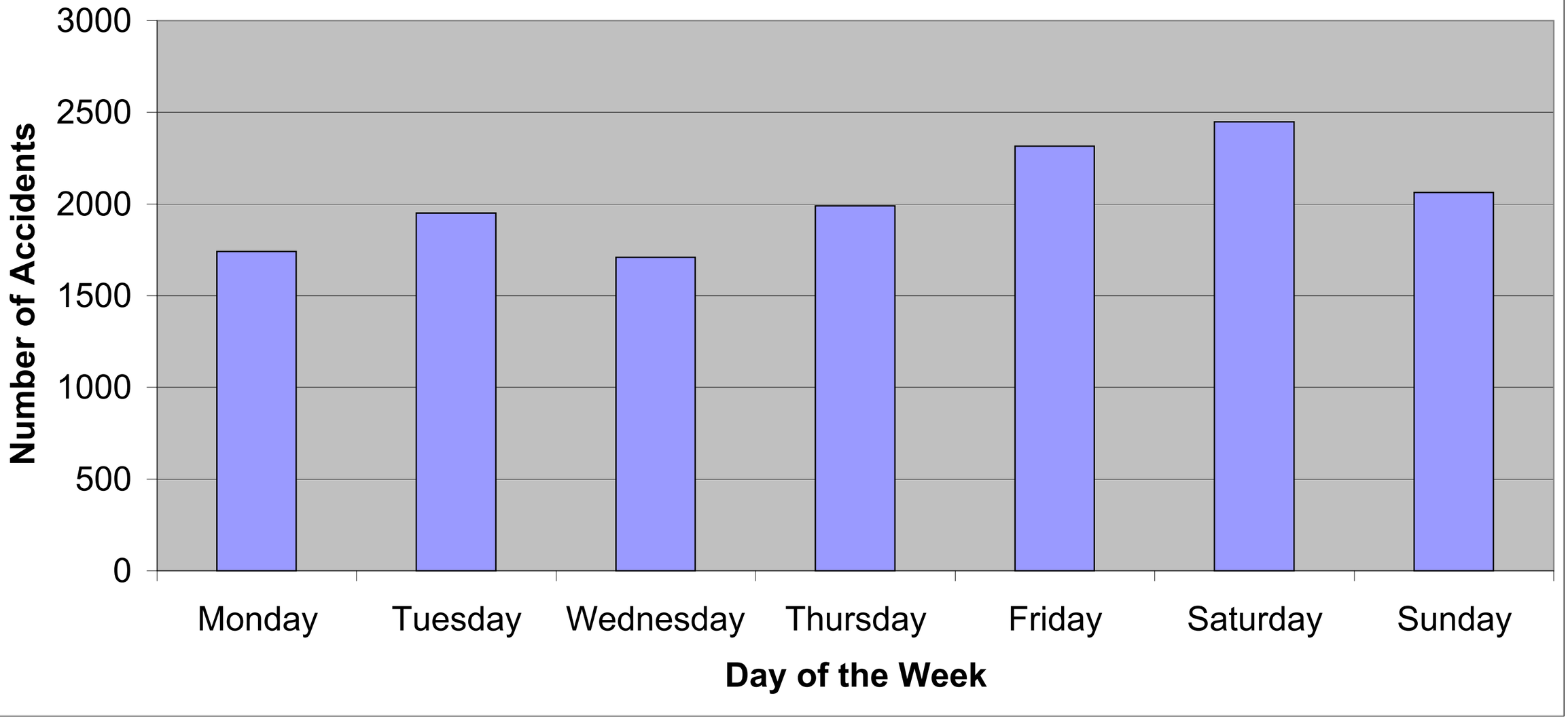
Division of Planning
and Development


Top 25 Accident Locations with Injured Persons
Number of Accidents
Location
Fatality Factor
>5 Injured
4 Injured
3 Injured
2 Injured
1 injured
0 Injured
0
20
40
60
80
100
120
140
160
0.42
0.52
0.30
0.35
0.32
0.38
0.88
0.36
0.50
0.58
0.49
0.28
0.35
0.44
0.51
0.47
0.31
0.48
0.48
0.24
0.44
0.67
0.43
0.31
0.81
Bridge St & VFW Hwy
Middlesex St & Wood St
Pawtucket St & School St
Chelmsford St & Plain St
Lord Overpass & Middlesex St
Lowell Connector & Plain St
Pawtucket Blvd, Rourke Bridge
Highland St & Thorndike St
Pine St & Wilder St
School St & Westford St
Dutton St & Market St
Church St & Lawrence St
E Merrimack St & High St
University Av & VFW Hwy
Broadway St & School St
Andover St & Nesmith St
Branch St & School St
Westford St & Wilder St
Bridge St & French St
Riverside St & University Av
Appleton St & Central St
Middlesex St & Stevens St
Aiken St & VFW Hwy
Mammoth Rd & VFW Hwy
Broadway St & Willie St

Lowell, Massachusetts Accident Total Per Hour of the Day 1998 - 2001



Lowell, Massachusetts
Accident Total Per Day of the Week
1998 - 2001



PAVEMENT CONDITION INDEX

- Fail
- Poor
- Fair
- Good
- Excellent

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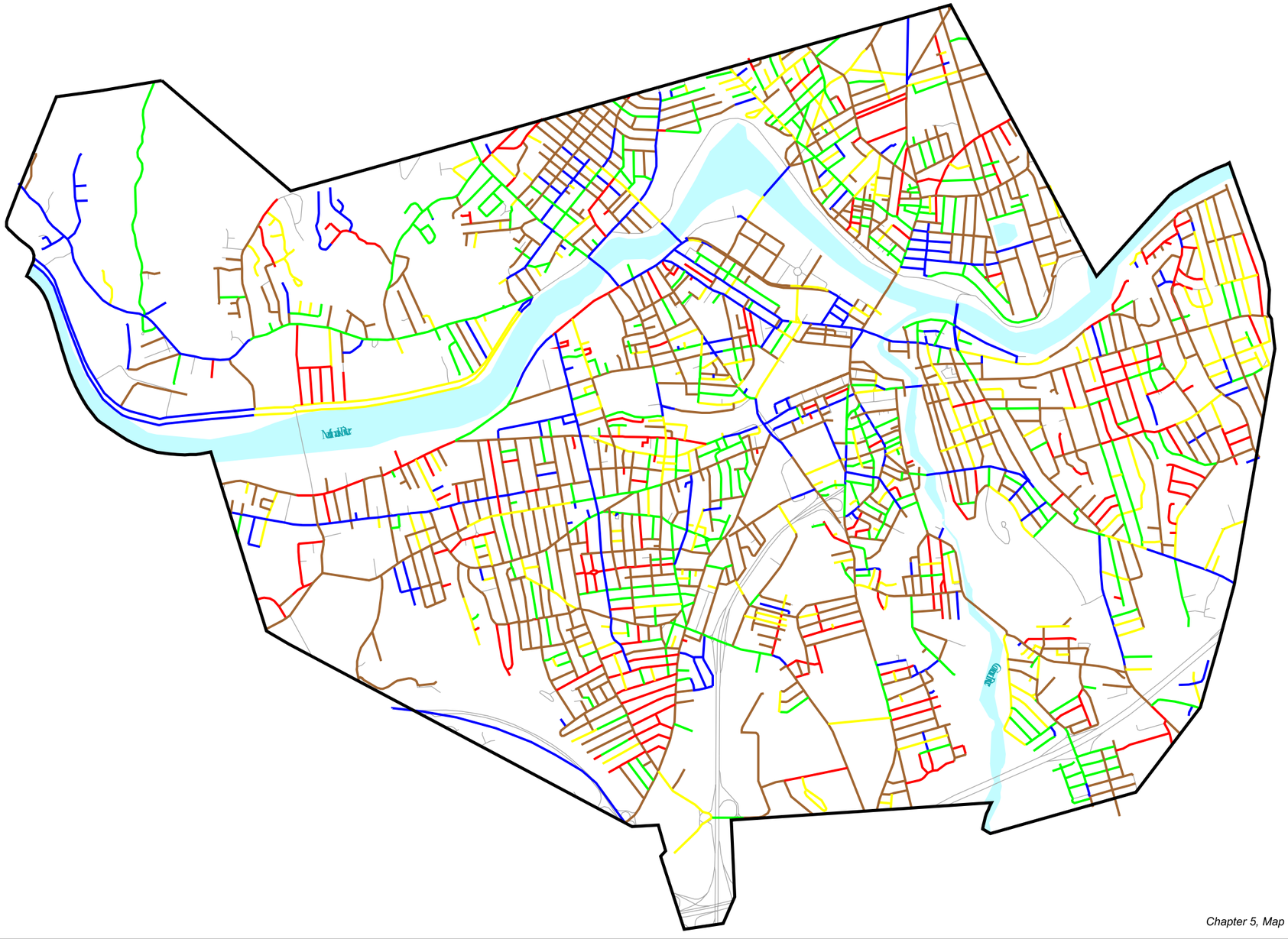


Chapter 5, Map 3

Pavement Condition

LOWELL COMPREHENSIVE PLAN
January 2002 Existing Conditions

N

0.8 0 0.8 1.6 Miles

Division of Planning and Development

SIDEWALK CONDITION

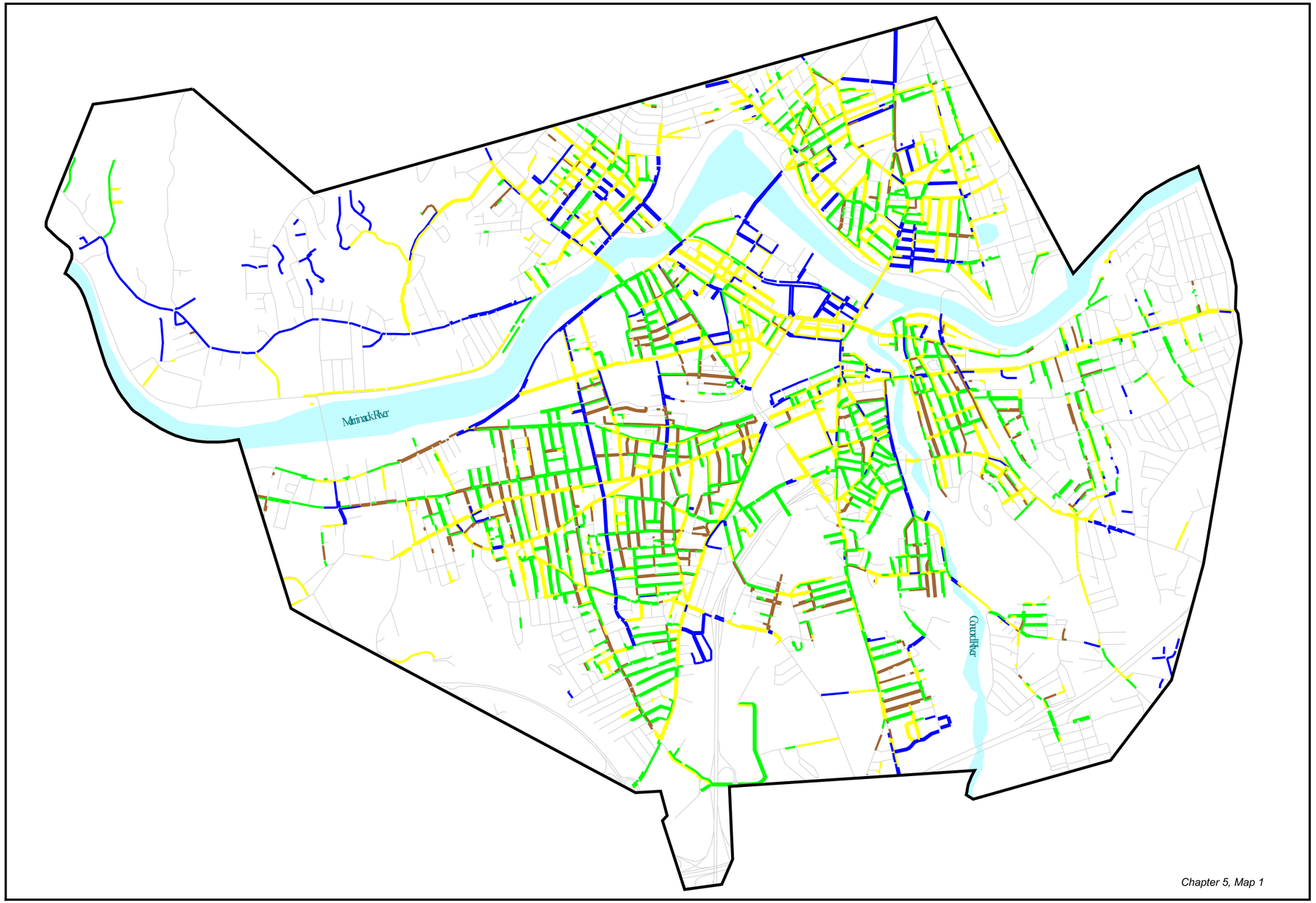
Poor

Fair

Good

Excellent

//cityhall-A2/Gisdata$/arcview/arc_projects/comprehensive_plan/traffic



Chapter 5, Map 1

Sidewalk Condition

LOWELL COMPREHENSIVE PLAN
January 2002 Existing Conditions

N

0.8 0 0.8 1.6 Miles

DPD

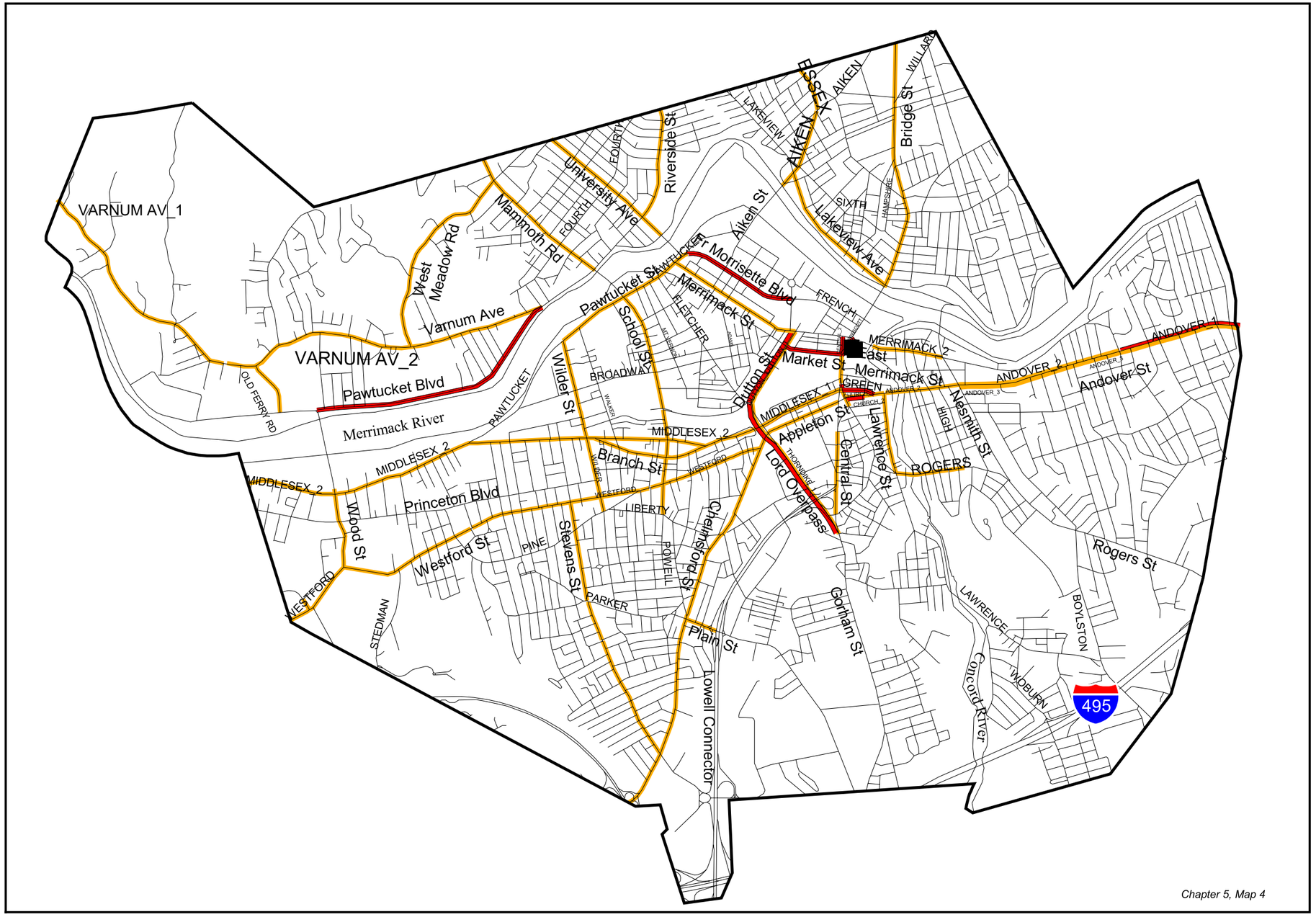
Division of Planning
and Development

PAINT TYPE

BWLL

DYCL

//cityhall-A2/Gisdata$/arcview/arc_projects/comprehensive_plan/traffic



Chapter 5, Map 4

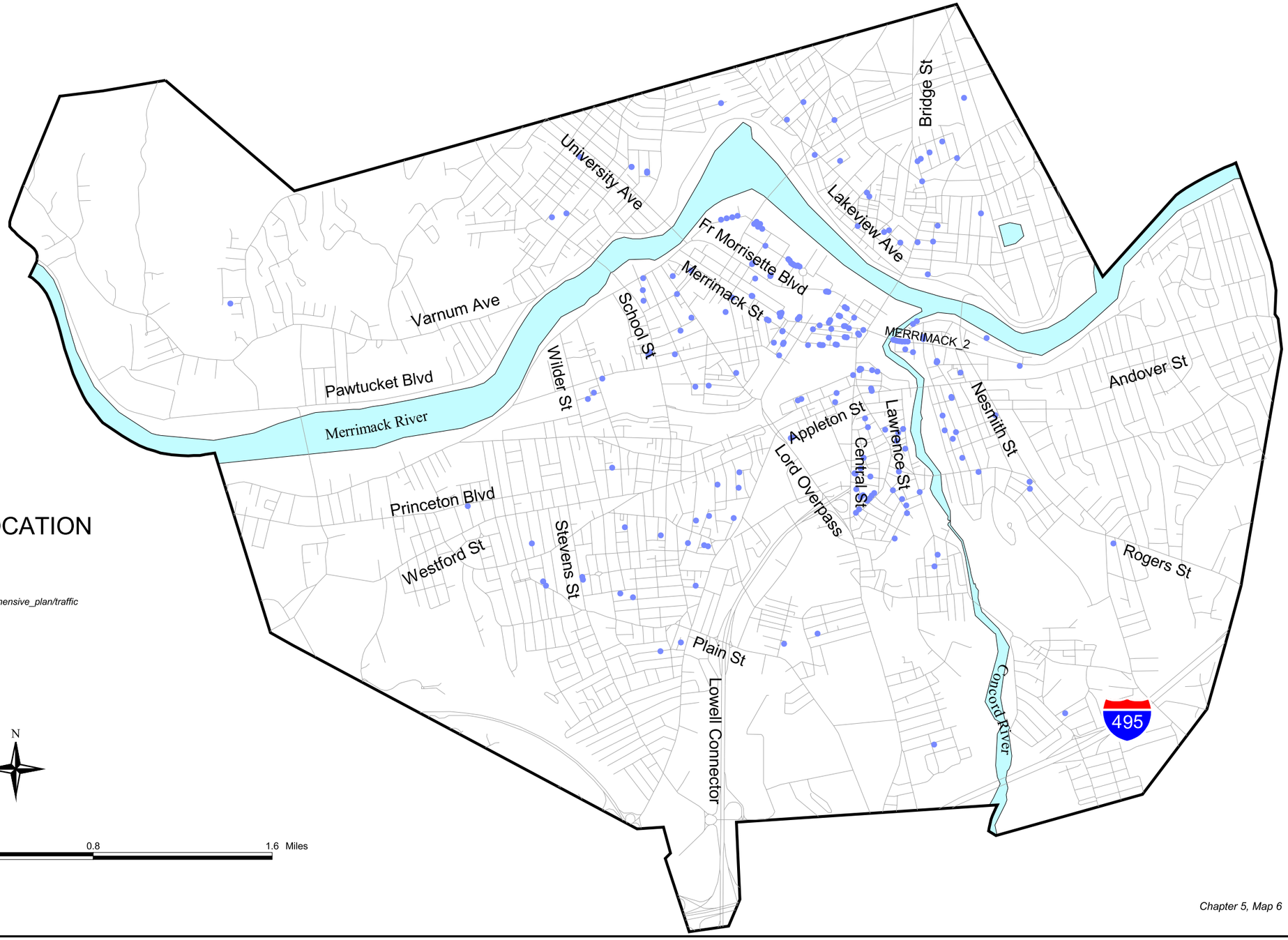
Pavement Markings

LOWELL COMPREHENSIVE PLAN
January 2002 Existing Conditions

N

0.8 0 0.8 1.6 Miles

Division of Planning and Development



- HANDICAP SIGN LOCATION

//cityhall-A2/Gisdata$/arcview/arc_projects/comprehensive_plan/traffic

N

0.8 0 0.8 1.6 Miles

Chapter 5, Map 6

Handicap Signs

LOWELL COMPREHENSIVE PLAN
January 2002 Existing Conditions

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